# State Water Resources Control Board

**Division of Clean Water Programs**
1001 I Street • Sacramento, California 95814 • (916) 341-5871
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FAX (916) 341-5808 • Internet Address: http://www.swrcb.ca.gov

**Winston H. Hickox**
*Secretary for Environmental Protection*

**Gray Davis**
*Governor*


October 24, 2001

TO: Interested Parties

**SURVEY FORM FOR SENSOR FIELD STUDY**

We are sending this letter to you, as someone who may have expertise in the performance of the various sensors used in UST systems. We are concerned about the performance of these sensors, specifically those in tank-top sumps, tank annular spaces, and under dispenser containment. As you know, their performance is critical in detecting leaks. Therefore, we have initiated our own study to evaluate their effectiveness under actual operating conditions.

We plan to visit 200 operating UST facilities and collect data on sensor performance. However, we recognize that our field study is limited and would be incomplete without input from those who have valuable first-hand experience with these sensors. Therefore, we are requesting your assistance to complete the enclosed survey form and return it to us. This will allow us to incorporate your knowledge and experience into our study. We estimate it will take approximately 30 minutes to complete the entire survey, however we are interested in your views even if you can only complete a portion.

Please distribute the survey to anyone in your organization who routinely works with UST leak detection sensors. This includes, but is not limited to, service technicians, inspectors, installers, and environmental managers. Please return the completed surveys by **November 15, 2001** to:

**Attention: Scott Bacon**
**State Water Resources Control Board**
**Department of Clean Water Program**
**P.O. Box 944212**
**Sacramento, CA 94244-2120**
**Fax: (916) 341-5808**

If you prefer, you may complete and submit the survey online at:
**http://www.calcupa.net/support/index.htm**

If you have any questions regarding this survey, please contact Scott Bacon at (916) 341-5873 or email: bacons@cwp.swrcb.ca.gov.

Sincerely,

- ORIGINAL SIGNED BY -

Shahla Dargahi Farahnak, P.E., Chief
Engineering Unit 2
Underground Storage Tank Program

Enclosure

# UST SENSOR STUDY SURVEY

STATE WATER RESOURCES CONTROL BOARD

(Please answer all the questions that are applicable based on your experience in the field)

**Information provided by: –** (Leave blank if you prefer to submit this survey anonymously)

**Name: _____ Company/Agency: _____**
**Address: _____ Telephone: _____**

## GENERAL INFORMATION

**1.** What is your affiliation? □ Local Agency Inspector □ Technician □ Consultant
□ Owner/Operator □ Other (*Specify)* _____

**2.** How many years of experience do you have in the UST field? _____

**3.** Average number of UST facilities you inspect/service monthly? _____ □ Not applicable

## OVERALL SENSOR INFORMATION

**4.** Do you perform/require a functional test (i.e. accessing the sensors and activating an alarm by flipping them over, immersing them in liquid, etc.) of all sensors during the annual UST monitoring equipment certification? □ Yes □ No

**5.** What percentage of the sensors you encounter in the field are failing the functional tests?

□ <5% □ 5-10% □ 10-20% □ 20-30% □ 30-40% □ 40-50% □ >50%

**6.** What percentage of the sensor failures are due to the following factors:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| a) Poor design: | □ <5% | □ 5-10% | □ 10-20% | □ 20-30% | □ 30-40% | □ 40-50% | □ >50% |
| b) Installation: | □ <5% | □ 5-10% | □ 10-20% | □ 20-30% | □ 30-40% | □ 40-50% | □ >50% |
| c) Maintenance: | □ <5% | □ 5-10% | □ 10-20% | □ 20-30% | □ 30-40% | □ 40-50% | □ >50% |
| d) Programming: | □ <5% | □ 5-10% | □ 10-20% | □ 20-30% | □ 30-40% | □ 40-50% | □ >50% |
| e) Tampering: | □ <5% | □ 5-10% | □ 10-20% | □ 20-30% | □ 30-40% | □ 40-50% | □ >50% |
| f) Other: | □ <5% | □ 5-10% | □ 10-20% | □ 20-30% | □ 30-40% | □ 40-50% | □ >50% |

**7.** Sensor failure is most common in: □ Steel Tanks □ Dry Interstice Fiberglass Tank
□ Wet Interstice Fiberglass Tank □ Tank-Top (pump/fill) Sumps
□ Under Dispenser Containment □ Location is not a factor in sensor failure

## SENSOR COMPARISON

**8.** Please complete this section to the best of your knowledge:

| | Float switch | Polymer strip | Optical Prism | Ultrasonic | Conductivity | Capacitance change |
|---|---|---|---|---|---|---|
| % failure rate | | | | | | |
| * Indicate most common reason(s) for failure | | | | | | |

*Failure Reasons: P = Programming M = Maintenance I = Installation T = Tampering
PD = Poor Design Other = Please indicate

**9.** What specific make(s) and/or model(s) of sensor are **most** reliable? _____
_____

**10.** What specific make(s) and/or model(s) of sensor are **least** reliable? _____
_____

## DISCRIMINATING SENSORS

**11.** What percentage of the sensors you use/inspect/service are discriminating sensors?

- Tank Interstice: □ <5% □ 5-10% □ 10-20% □ 20-30% □ 30-40% □ 40-50% □ >50%
- Turbine Sumps: □ <5% □ 5-10% □ 10-20% □ 20-30% □ 30-40% □ 40-50% □ >50%
- Under Dispenser: □ <5% □ 5-10% □ 10-20% □ 20-30% □ 30-40% □ 40-50% □ >50%

**12.** Based on your experience, discriminating sensors are _____ when compared to non-discriminating sensors?

□ **More** reliable □ **Less** reliable □ **Equally** reliable

**13.** For discriminating sensors using polymer strip, what is the typical time for each of the following?

a) response in unleaded fuel:
□ <30sec □ 30-60sec □ 1-3min □ 3-5min □ 5-10min □ 10-20min □ >20min

b) recovery in unleaded fuel:
□ <1min □ 1-3min □ 3-5min □ 5-10min □ 10-20min □ >20min □ Not reusable

c) response in diesel fuel:
□ <30sec □ 30-60sec □ 1-3min □ 3-5min □ 5-10min □ 10-20min □ >20min

d) recovery in diesel fuel:
□ <1min □ 1-5min □ 5-15min □ 15-30min □ 30-60min □ >60min □ Not reusable

**14.** Is there a change in response times for polymer strip sensors after repeated exposure to fuel?

□ Response time for polymer-strip sensors **increases** after repeated exposure to hydrocarbons.
□ Response time for polymer-strip sensors **decreases** after repeated exposure to hydrocarbons.
□ Response time for polymer strip sensors **does not change** after repeated exposure to hydrocarbons.

**15.** Which of the following methods do you most often use/require when testing discriminating sensors?

□ Test in **water** only □ Test in **product** only □ Test in **both** product and water
□ Flip sensor over □ I do not test/require testing of discriminating sensors

## PUMP SHUT-DOWN FEATURE

**16.** What is the typical time delay between sensor activation and pump shut-down?

□ <5sec □ 5-10sec □ 10-30sec □ 30-45sec □ 45-60sec □ 1-2min □ >2min

**17.** For sensors programmed for pump shut-down, what percent of them shut down the pump?

□ <5% □ 5-10% □ 10-20% □ 20-30% □ 30-40% □ 40-50% □ >50

**18.** What are the most common reason(s) for failure of the pump shut-down?

□ Programming □ Maintenance □ Installation □ Tampering
□ Relay box (Equipment problems) □ Other (Specify) _____

## ADDITIONAL INFORMATION

**19.** What changes can be made to improve sensor reliability?_____

_____
_____
_____
_____

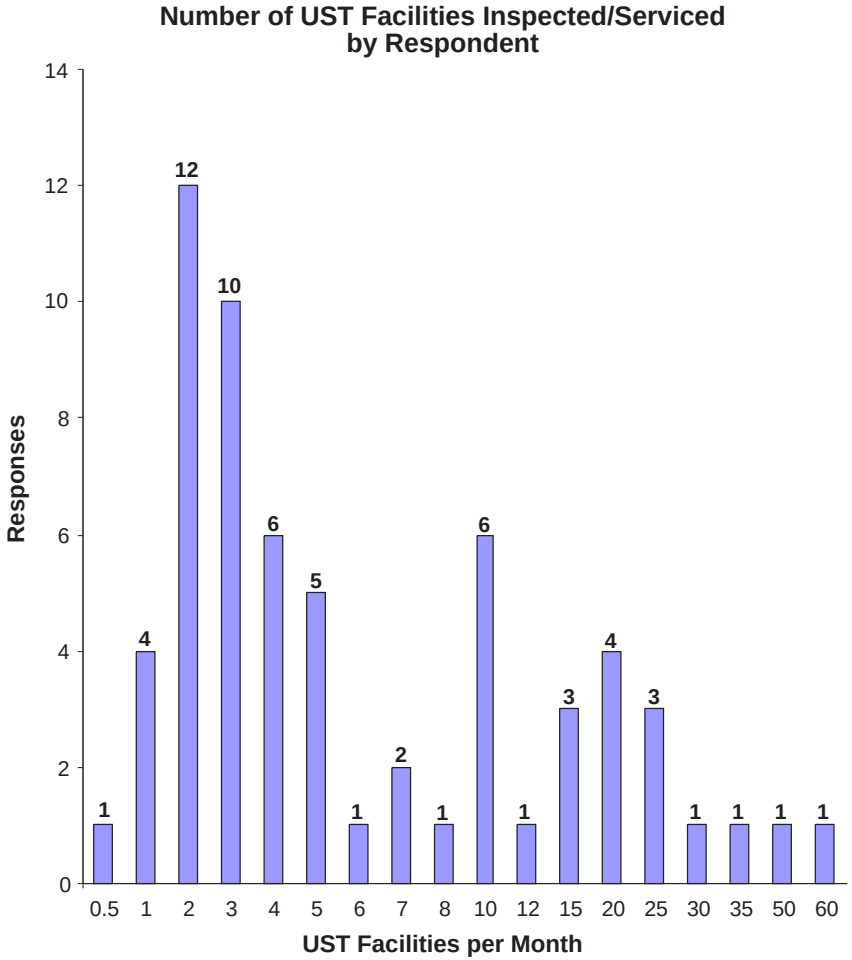
**20.** Do you have any other comments you would like to share with us? _____

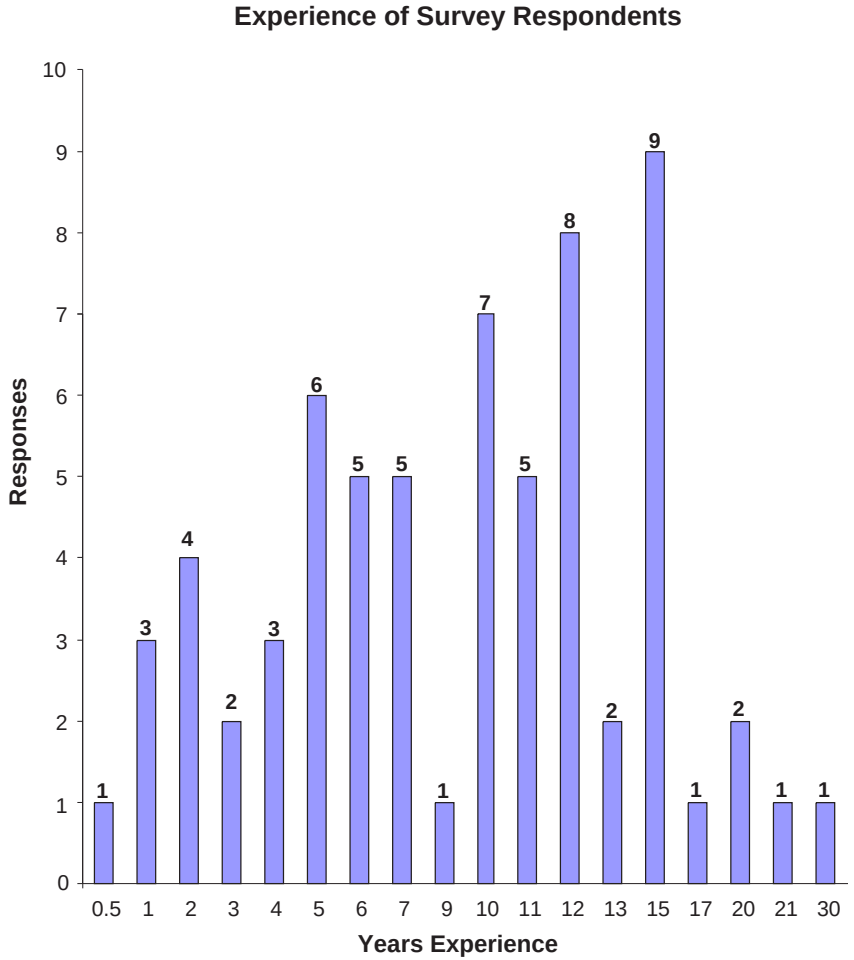
_____
_____
_____
_____

# SWRCB Sensor Field Evaluation, Survey Results

71 local agency inspectors and service technicians responded to the survey. The following tables summarize their responses to a variety of questions on UST leak detection sensors.

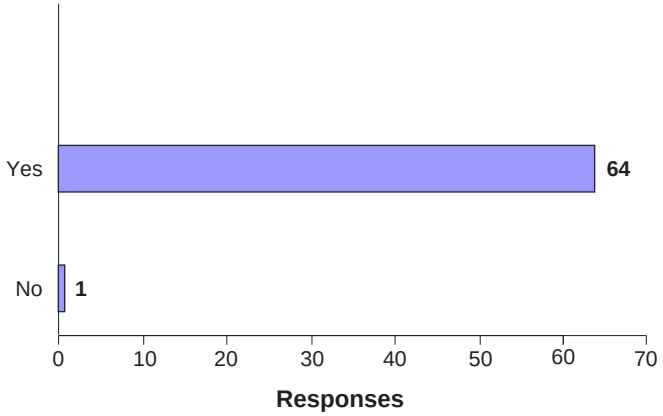
## ABOUT THE RESPONDENTS



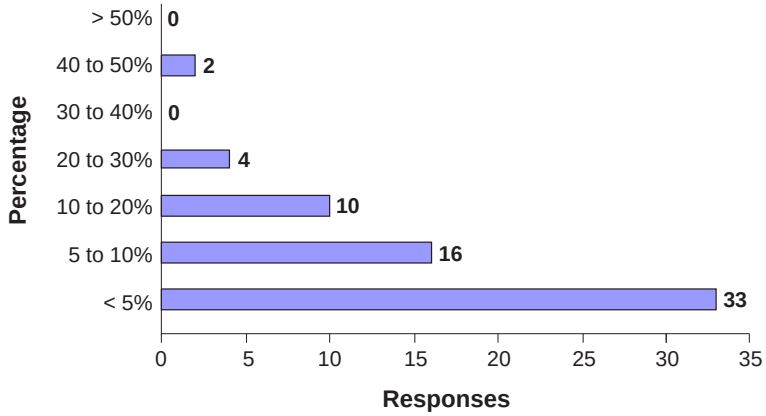



# GENERAL SENSOR INFORMATION

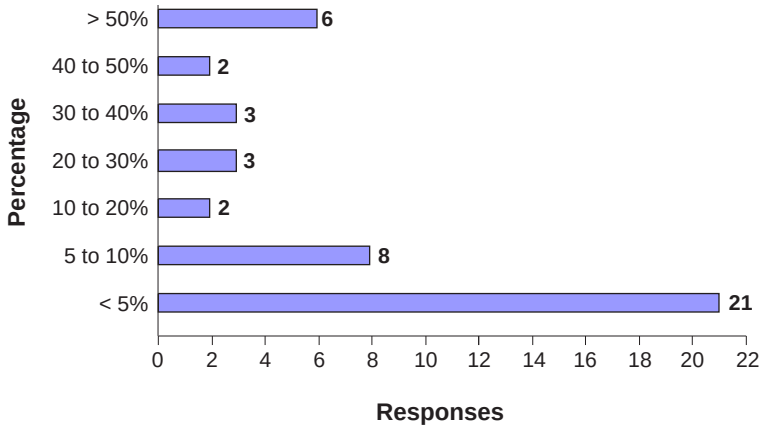
### Do you Require Functional Test of Sensors?



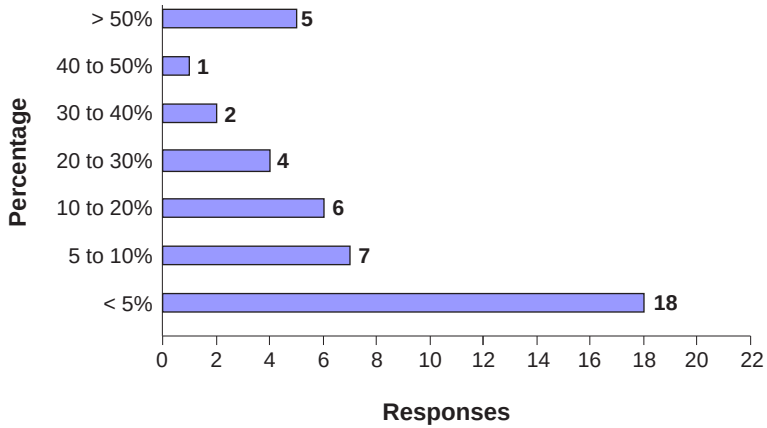

### Percentage of Sensors Failing Functional Test

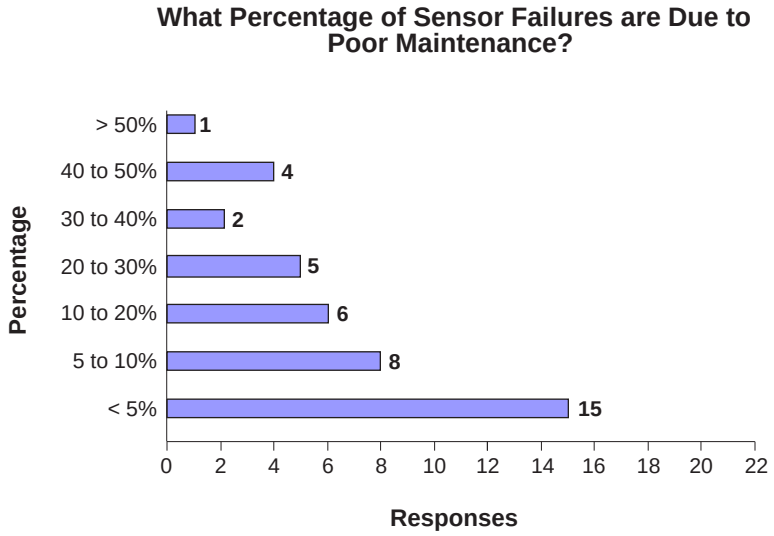


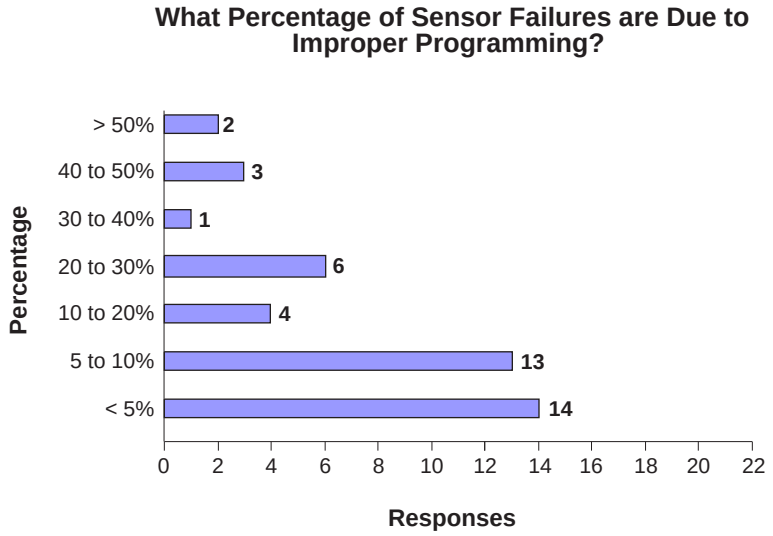

### What Percentage of Sensor Failures are Due to Poor Design?

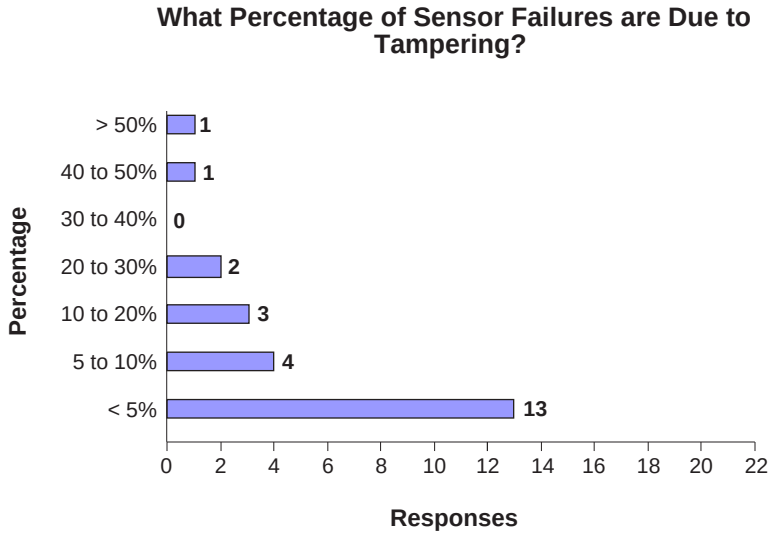


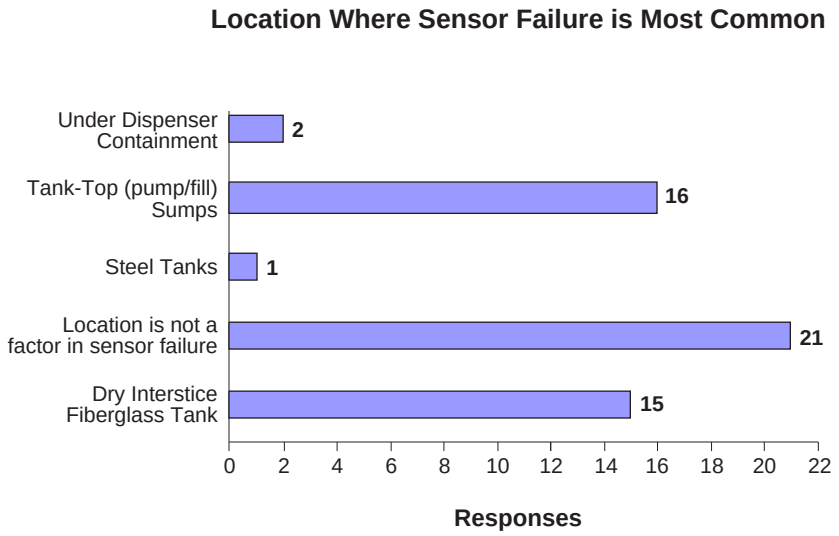

### What Percentage of Sensor Failures are Due to Poor Installation?




What Percentage of Sensor Failures are Due to Poor Maintenance?
Percentage
> 50%
40 to 50%
30 to 40%
20 to 30%
10 to 20%
5 to 10%
< 5%
1
4
2
5
6
8
15
0 2 4 6 8 10 12 14 16 18 20 22
Responses

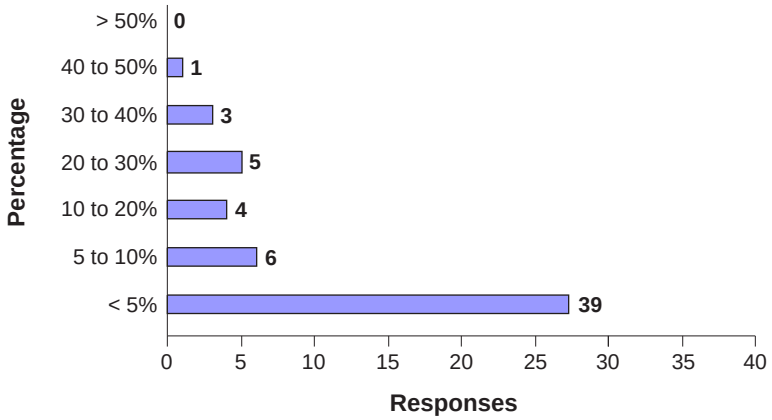

What Percentage of Sensor Failures are Due to Improper Programming?
Percentage
> 50%
40 to 50%
30 to 40%
20 to 30%
10 to 20%
5 to 10%
< 5%
2
3
1
6
4
13
14
0 2 4 6 8 10 12 14 16 18 20 22
Responses


What Percentage of Sensor Failures are Due to Tampering?
Percentage
> 50%
40 to 50%
30 to 40%
20 to 30%
10 to 20%
5 to 10%
< 5%
1
1
0
2
3
4
13
0 2 4 6 8 10 12 14 16 18 20 22
Responses

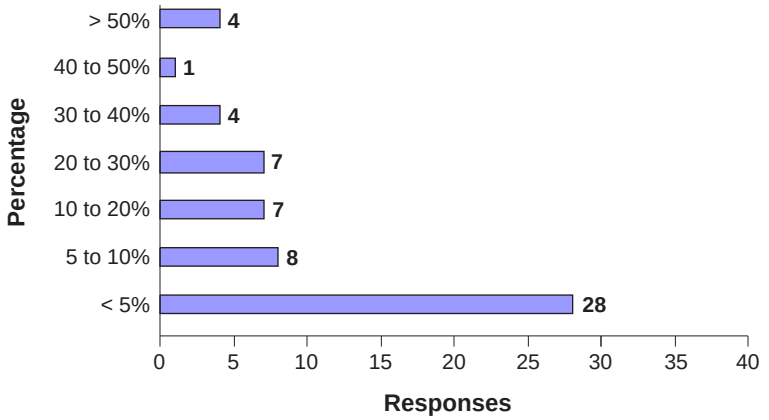

Location Where Sensor Failure is Most Common
Under Dispenser Containment
Tank-Top (pump/fill) Sumps
Steel Tanks
Location is not a factor in sensor failure
Dry Interstice Fiberglass Tank
2
16
1
21
15
0 2 4 6 8 10 12 14 16 18 20 22
Responses

# DISCRIMINATING SENSOR INFORMATION

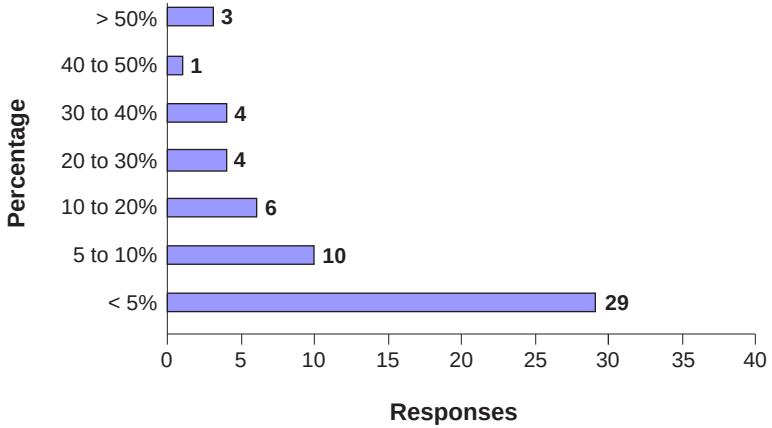
## Percentage of Discriminating Sensors in Tank Interstice



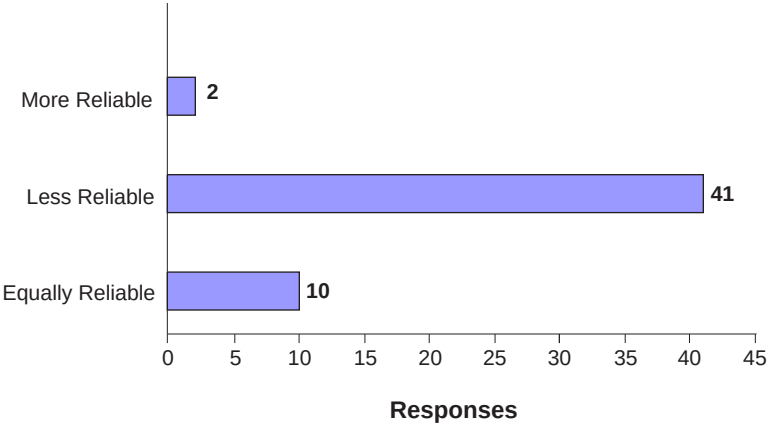

## Percentage of Discriminating Sensors in Turbine Sumps



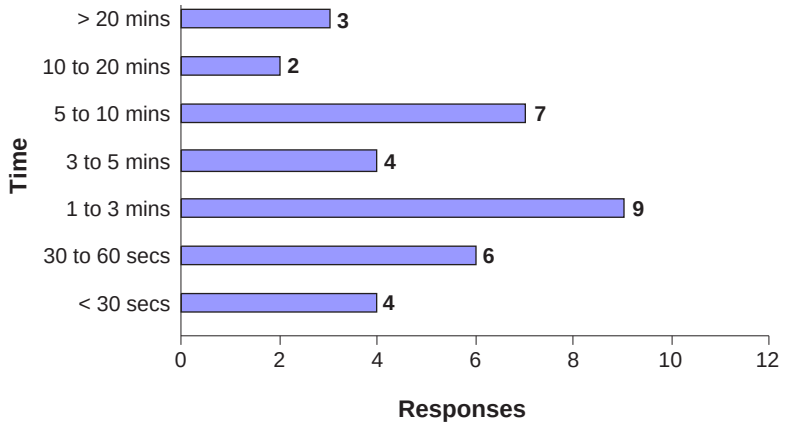

## Percentage of Discriminating Sensors in UDC



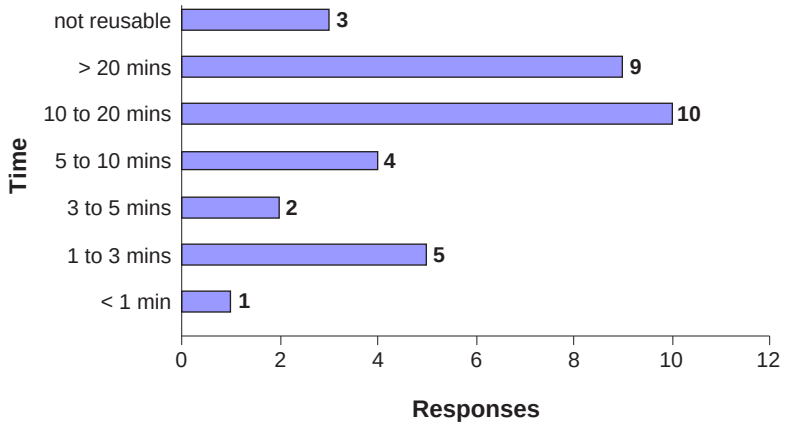

## Reliability of Discriminating Sensors as Compared to Non-Discriminating



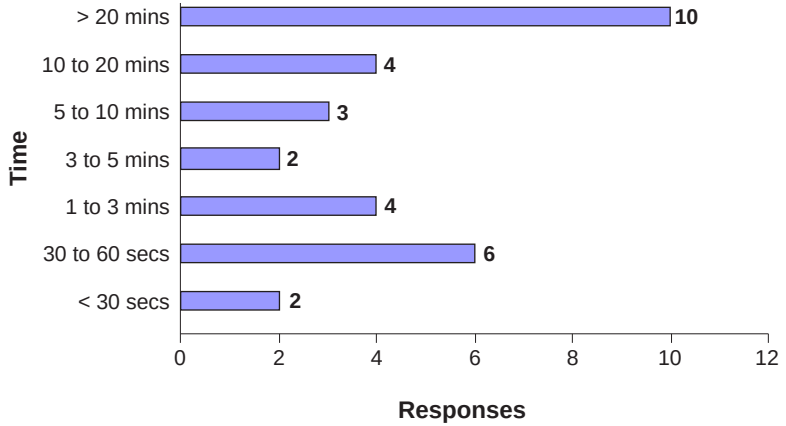
### Discriminating Sensor Response Time in Unleaded Fuel



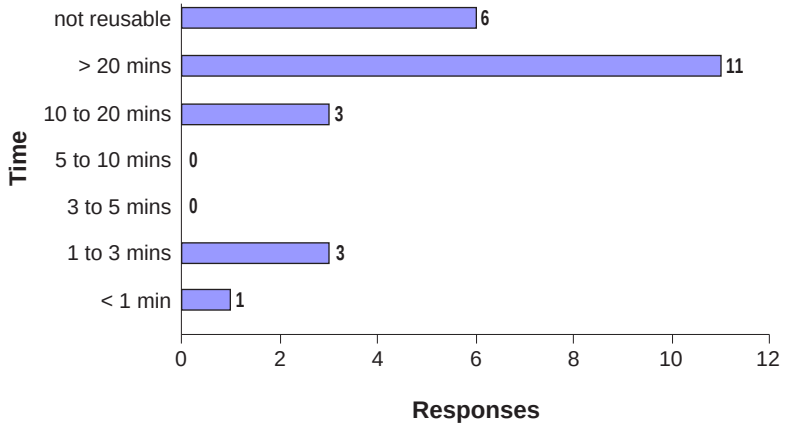

### Discriminating Sensor Recovery Time in Unleaded Fuel

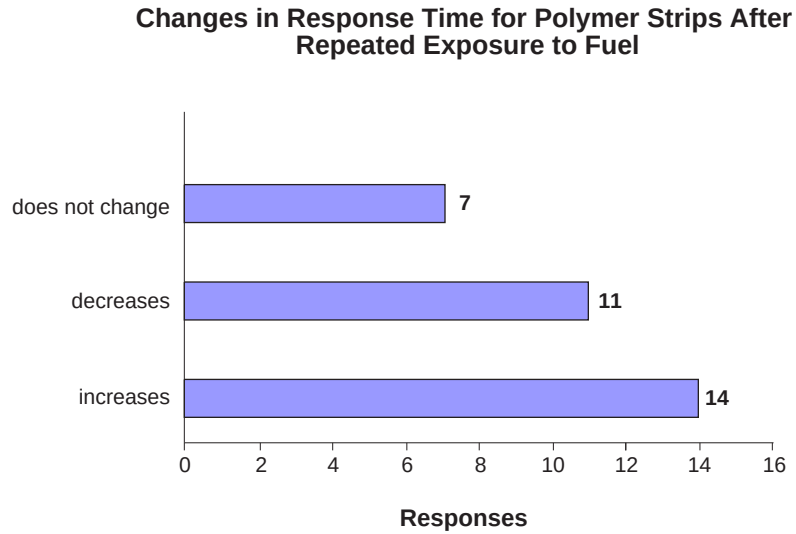


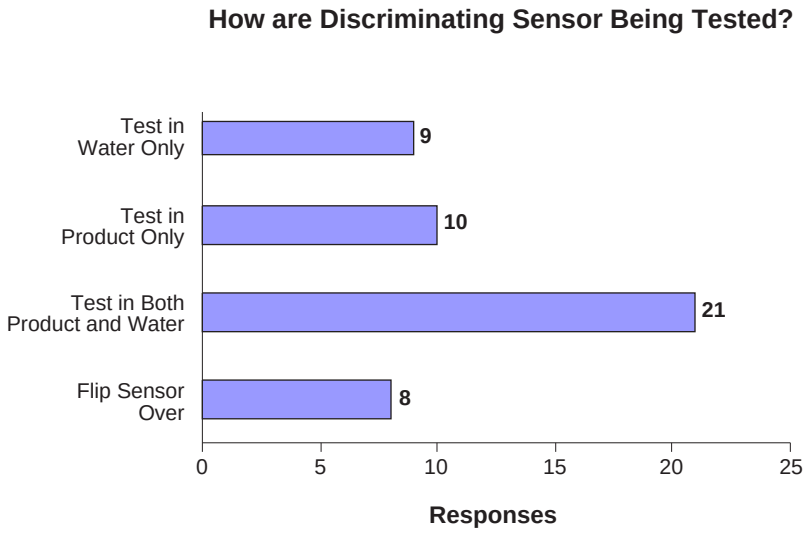

### Discriminating Sensor Response Time in Diesel Fuel



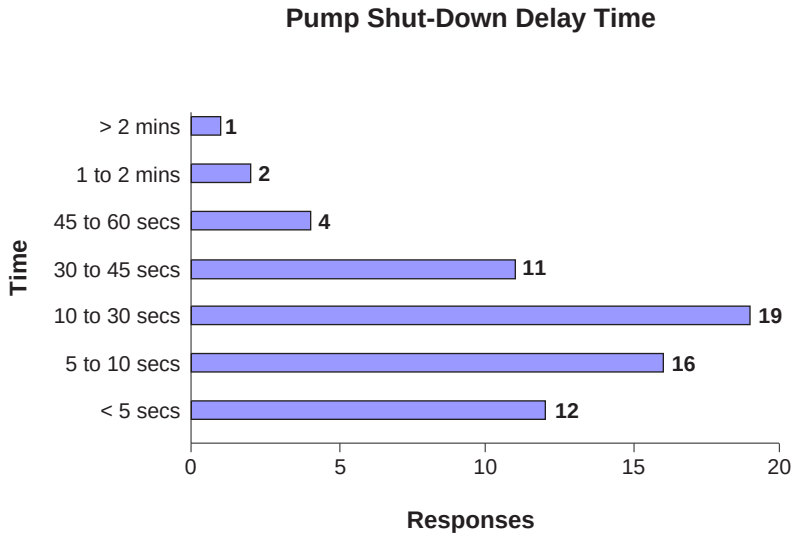

### Discriminating Sensor Recovery Time in Diesel Fuel

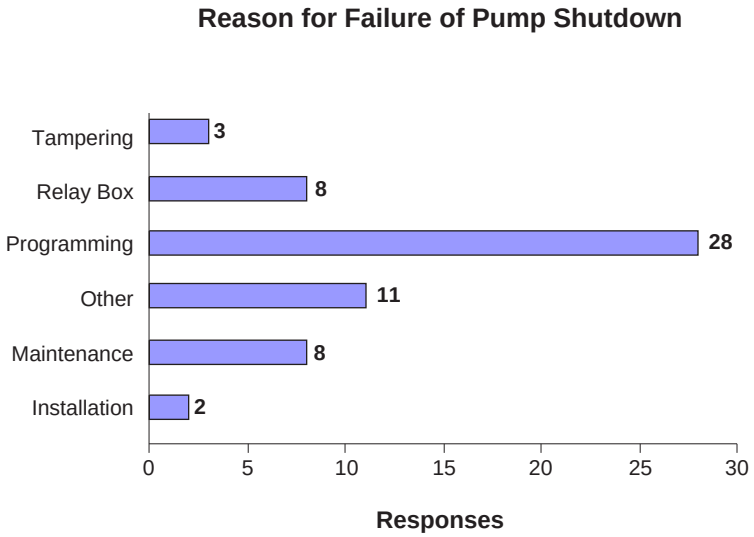





## PUMP SHUT-DOWN INFORMATION



# Online Survey Comments and Recommendations for the Sensor Field Evaluation of Underground Storage Tanks:

This is a compilation of comments and recommendations we received from our survey participants. These comments represent the views of the participants surveyed and may not reflect the opinions of the SWRCB.

- Discriminating sensors must be able to be tested in the actual product and must clear within a few minutes.
- Improve maintenance of sensors and replace outdated ones.
- The polymer strip type sensor appears to be a poor design for immediate identification of a leak. Remove this type from the approval list.
- Do not allow the use of sensors associated with the MSA Tankguard. I'm not sure, but I believe that they are polymer strip discriminating sensors. They have an extremely low response and recovery time of about 15-20 minutes. Also the sensitivity of the MSA Tankguard can be adjusted and always seems to need to be adjusted at each inspection. The alarm may not sound when the sensor is being tested in liquid, but then sound when it is not being tested. I do not trust the reliability of these sensors.
- Operator training, proper maintenance and tamper proofing.
- Eliminate discriminating sensors altogether in annular spaces. Heck, eliminate them everywhere. They are only good for sumps and containment areas that are so poorly constructed that liquid intrusion is a constant problem. Repairing the sumps would be a better solution to liquid intrusion problems.
- The positive shut down sump sensors are plastic and they stick open. Some type of new stick product is needed.
- You might want to require that all sensors be replaced regularly every 2-3 years.
- Eliminate discriminating sensors unless they have <5sec-response time. They need to be designed so that corrosion and sticking do not occur. Needs to be such that maintenance is minimized since this is only done annually.
- Require quarterly maintenance and inspection of sensors.
- Make them simple and easy to place. The Tri-State feature is best on systems that have no maintenance crew.
- Overall experience with discriminating sensors is minimal, but due to survey set cases/problems, we do not allow or will approve them for use in the city. Result is problematic.
- Better design, stronger materials, and no resistors at sensor end.
- Improve design on brands listed in question 10. Discriminating sensors are not practical. I do not test them due to recovery time. Sometimes they do not recover.
- I don't know if it is possible, but what if they made a sensor that was non-stick so that sludge would not hold the float, making it stuck. The contact points would also need to be sludge proof.
- Better installation practices. Sensors are not being hung at the correct location, i.e. at the bottom of the tank or sump.

- Eliminate discriminating sensors or improve technology. Operate and test sensors under various simulated conditions. Improve technology of annular float sensors in FG tanks to improve accessibility/visual inspection/simulated testing.

- Be there at the annual maintenance checks. You learn a lot, see a lot of the important violations and disrupt the business only once. The entire focus of my inspections is the leak detection systems for piping and tanks. They must work. Operators do not like to do leak detection manually. Pushing toward all electronic monitoring is essential for the future. Get the operators out of it. Have the ATG print out the monthly .2 gph-passing test for tanks at least once a month automatically. Then the operator saves this record for the inspection.

- Testers hate to test the discriminating sensors with product because they know they will have problems getting them cleared, if at all. If the sensors won't clear, then it must be replaced, and tested. On one occasion, the technician did not have a discriminating sensor replacement with him so he had to call his shop and have someone drive one out to the site. This kept that product offline for several hours. The facility operator was not happy.

- Get rid of sacrificial sensors, and require secondary containment for all piping!!!

- My primary objective in completing this survey is to expose the problems that I have encountered in trying to test the sensors for the MSA Tankguard system. All other sensors that I have encountered are sufficiently reliable.

- The compatibility of simple contact switch sensors with the control panels is not a major issue or an operational problem. The use of discriminating sensors is a major issue even when these sensors are used with a compatible control panel.

- We hardly see discriminating sensors. The alarm needs to go through a central alarm system in which case we will know of any release. Tampering defeats the purpose of monitoring. We find improper positioning of the probe/ raised probe 80 % of the sites. Water intrusion a real problem.

- A tank system that is properly constructed and maintained should never have liquid intrusion problems and therefore there is no need for discriminating sensors.

- Owners need a good, simple manual on the tank system components, requirements, and responsibilities: like "straight talk on tanks" in more detail. So many stations change hands and so many employees are dueless, that comprehensive explanation of UST's is desperately needed to start to get an unformed constituency.

- Bravo box float mechanisms for dispenser containment monitoring were not mentioned in this survey but have about a 50% failure rate due to debris or loose chains. SFSFD water tests all float monitored dispenser pans.

- Sensor reliability or rather the lack there of, has caused local agencies to all other leak detection and testing requirements to UST's. The confidence level in the sensors functioning properly at any given time is low, Because of this the confidence in our UST programs goal of preventing and detecting releases is also somewhat low. Why spend a lot of time and resources when the devices are unreliable? Also, this didn't address mechanical systems. The Bravo Float system has chronic problems with not functioning properly after more than a year. The float does not leave very much room for sidewalls of channels so dirt freezes the movement. Tampering by loosening chains is extremely common. We dislike this design.

- Phasing out existing monitoring systems. I.e. pollulert, petrometer, leak-x, petrovend, etc. Notion current LG-113 should be an eventually to start planning for now.

- Discriminating sensors add approximately 10 min. per sensor for testing and returning to operability. That adds about 2 hours to a standard gas station monitoring certification inspection.

- Question 13(d)- recovery time for diesel fuel is greater than 60 minutes.

- Please remove discriminating sensors from approved method. They are not reliable and/or do not sense for reasonable system monitoring (if located in sump bottom with water in sump a full leak will not be detected if the water level is above the sensor). Question 7-Sensor failure is most common in Tank Top (pump/fill) Sumps and Under Dispenser Containment.

- This survey should allow free-text answers. Some pick-list choices are inadequate. At the very least, there should be a "unknown" response.

- In the past when we arrived on site for an inspection, the maintenance contractor or operator may have already tested and replaced any faulty sensors. This will skew the data you collect from inspectors, indicating higher performance rates.

- People raising probes due to surface water infiltration via rain or steam cleaning the parking lot, which violates many laws.

- Alternate technologies should be available for positive shutdown, which do not rely on the relay boxes.